



# MSMR

## Medical Surveillance Monthly Report

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*Data in the MSMR are provisional, based on reports and other sources of data available to the Army Medical Surveillance Activity. Notifiable events are reported by date of onset (or date of notification when date of onset is absent). Only cases submitted as confirmed are included.*

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## Surveillance Trends

### **Eye Injuries among Active Duty Soldiers, US Army, 1993-1998**

The nature and severity of eye injuries depend on physical characteristics of impacting objects (e.g., mass, size, speed, hardness, sharpness), locations of impacts, and predispositions of the eye to various injuries. Corneal abrasions are the most common eye injury. They occur when small foreign objects (e.g., sand, twigs, wood shavings, metal particles) scratch the cornea. Objects with more momentum and sharpness can lacerate eyes or eyelids and create open wounds. Blunt objects (e.g., fists, baseballs) that are larger than orbital openings can cause periocular contusions ("black eyes"). Traumatic encounters with blunt objects can fracture the orbital floor, the thin bone beneath the eye. Serious blows to the head can injure cranial nerves, which control eye movements, or the optic nerve, which is essential to vision. Finally, fire, chemicals (e.g., antifreeze, household cleaners, industrial and laboratory reagents), and radiation (e.g., welding arcs, lasers) can burn external or internal structures of the eye. Many occupational, recreational, and military activities are inherently hazardous to the eyes.<sup>1-5</sup>

**Methods:** Analyses were designed to characterize the nature, extent, and incidence of eye injuries among active duty soldiers. The study population included all soldiers who served in the active component of the US Army between Octo-

ber 1992 and December 1998. Records maintained in the Defense Medical Surveillance System (DMSS) were searched to identify all hospitalizations during the study period and all ambulatory visits between October 1997 and December 1998 for which primary diagnoses were specific for eye injuries (53 codes in the International Classification of Diseases, 9th revision, Clinical Modification, were identified as eye injury specific diagnoses).

In order to separate new ("incident") injuries from follow-ups of previously diagnosed cases, "recovery periods" (number of days following incident case reports) were estimated for each of the 53 injuries of interest (table 1) (Buckingham, R, Cornforth, L, Blatterman, A, McDuffie, D., Personal communication).<sup>6</sup> For analysis purposes, multiple hospitalizations or ambulatory visits of individual soldiers that (a) had identical injury-related diagnoses and (b) occurred during injury-specific "recovery periods" were counted as single cases with followups, rather than as multiple cases. "Short" and "long" recovery periods were used to reflect the ranges of clinical severity associated with particular injuries and to assess the sensitivity of analyses to various recovery period durations.

**Results:** Table 1 lists the 53 eye injury diagnoses of interest, estimated ranges of recov-

*Continued on page 7*

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Table 1. Eye injuries by diagnostic category and case definition, active duty soldiers

Major Diagnostic Category		Recovery Period: days between incident cases <sup>1</sup>		Number Hospitalizations <sup>2</sup> 1993-1998		Number Ambulatory Visits <sup>3</sup> 1998	
ICD-9	Injury Description	Short <sup>4</sup>	Long <sup>5</sup>	Short <sup>4</sup>	Long <sup>5</sup>	Short <sup>4</sup>	Long <sup>5</sup>
<b>Orbital floor fracture</b>							
802.6	Closed	210	∞	258	258	80	75
802.7	Open	150	∞	13	13	3	2
	<b>Subtotal</b>			<b>271</b>	<b>271</b>	<b>83</b>	<b>77</b>
<b>Open wound</b>							
870.0	Skin of eyelid and periocular area	30	∞	46	46	40	40
870.1	Eyelid, full-thickness	30	∞	20	20	5	5
870.2	Eyelid with lacrimal passages	120	∞	19	19	2	2
870.3	Orbit	90	∞	4	4	2	2
870.4	Orbit with foreign body	90	∞	10	10	3	3
870.8	Other specified of ocular adnexa	90	∞	93	93	148	147
870.9	Unspecified of ocular adnexa	90	∞	9	9	3	3
871.0	Ocular without prolapse of intraocular tissue	90	∞	28	28	9	9
871.1	Ocular with prolapse of intraocular tissue	90	∞	24	23	1	1
871.2	Eye with partial loss of intraocular tissue	180	∞	15	15	0	0
871.3	Avulsion of eye	∞	∞	9	9	4	4
871.4	Unspecified of eye	90	∞	41	41	48	47
871.5	Eyeball with magnetic foreign body	∞	∞	19	19	13	13
871.6	Eyeball with nonmagnetic foreign body	∞	∞	32	32	17	17
871.7	Unspecified ocular	90	∞	20	20	17	9
871.9	Unspecified of eyeball	90	∞	18	18	44	44
	<b>Subtotal</b>			<b>407</b>	<b>406</b>	<b>356</b>	<b>346</b>
<b>Superficial injury of eye and adnexa</b>							
918.0	Eyelids and periocular area	7	90	12	12	151	142
918.1	Corneal abrasion	2	∞	120	119	2,578	2,431
918.2	Conjunctiva	2	30	5	5	29	29
918.9	Other, unspecified	2	∞	8	8	82	80
	<b>Subtotal</b>			<b>145</b>	<b>144</b>	<b>2,840</b>	<b>2,682</b>
<b>Contusion of eye and adnexa</b>							
921.0	Black eye, NOS	2	30	24	24	17	17
921.1	Eyelids and periocular area	2	30	43	43	48	48
921.2	Orbital tissues	2	∞	51	51	88	69
921.3	Eyeball	2	∞	188	183	243	171
921.9	Unspecified	2	∞	42	42	606	502
	<b>Subtotal</b>			<b>348</b>	<b>343</b>	<b>1,002</b>	<b>807</b>
<b>Foreign body on external eye</b>							
930.0	Corneal foreign body	2	30	10	10	541	501
930.1	Foreign body in conjunctival sac	2	7	5	5	25	25
930.2	Foreign body in lacrimal punctum	2	7	0	0	1	1
930.8	Other and combined sites	2	14	4	4	43	43
930.9	Unspecified	2	14	9	9	618	600
	<b>Subtotal</b>			<b>28</b>	<b>28</b>	<b>1,228</b>	<b>1,170</b>
<b>Burn to eye and adnexa</b>							
940.0	Chemical burn of eyelids and periocular area	7	∞	0	0	16	16
940.1	Other burn of eyelids and periocular area	7	∞	2	2	7	7
940.2	Alkaline burn of cornea, conjunctival sac	14	∞	2	2	4	4
940.3	Acid burn of cornea, conjunctival sac	14	∞	3	3	1	1
940.4	Other burn of cornea,conjunctival sac	14	∞	15	15	21	20
940.5	Burn with destruction of eyeball	∞	∞	1	1	0	0
940.9	Unspecified burn of eye and adnexa	14	∞	4	4	59	59
941.02	Unspecified degree	14	∞	2	2	2	2
941.12	Erythema	14	30	3	3	1	1
941.22	Blisters, epidermal loss	30	∞	9	9	1	1
941.32	Full-thickness skin loss	90	∞	0	0	0	0
941.42	Deep necrosis of underlying tissues	90	∞	1	1	0	0
941.52	Deep necrosis with loss of body part	∞	∞	0	0	0	0
	<b>Subtotal</b>			<b>42</b>	<b>42</b>	<b>112</b>	<b>111</b>
<b>Injury to optic or cranial nerves</b>							
950.0	Optic nerve injury,second cranial nerve	14	∞	17	17	13	2
950.1	Injury to optic chiasm	14	∞	0	0	0	0
950.2	Injury to optic pathways	14	∞	0	0	0	0
950.3	Injury to visual cortex	14	∞	0	0	1	1
950.9	Unspecified, traumatic blindness NOS	14	∞	8	8	2	2
951.0	Injury to oculomotor, third cranial nerve	45	∞	3	3	0	0
951.1	Injury to trochlear, fourth cranial nerve	45	∞	2	2	0	0
951.3	Injury to abducens, sixth cranial nerve	45	∞	1	1	0	0
	<b>Subtotal</b>			<b>31</b>	<b>31</b>	<b>16</b>	<b>5</b>
<b>Total</b>				<b>1,272</b>	<b>1,265</b>	<b>5,637</b>	<b>5,198</b>

<sup>1</sup> Buckingham, *et al.* <sup>2</sup> Beginning with Oct., 1992 data <sup>3</sup> Beginning with Oct., 1997 data <sup>4</sup> Minimum recovery period <sup>5</sup> Maximum recovery period

**Table I. Sentinel reportable events, US Army medical treatment facilities<sup>1</sup>**  
**Cumulative events for all beneficiaries, calendar year through August 31, 1998 and 1999<sup>2</sup>**

Reporting Facility	Number of reported events <sup>3</sup>		Environmental				Food-borne							
			Cold		Heat		Campylobacter		Giardia		Salmonella		Shigella	
	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999
<b>NORTH ATLANTIC RMC</b>														
Walter Reed AMC, DC	136	134	-	-	-	-	6	3	4	4	5	2	-	-
Aberdeen Prov. Grd., MD	30	23	-	-	2	-	-	-	-	-	-	-	-	-
FT Belvoir, VA	174	153	-	-	5	2	5	6	3	6	9	8	1	2
FT Bragg, NC	77	891	1	8	20	101	4	5	-	2	28	21	18	-
FT Drum, NY	140	165	14	15	-	3	1	1	1	3	-	1	-	-
FT Eustis, VA	148	143	-	1	18	3	2	-	-	-	2	4	4	1
FT Knox, KY	202	200	-	2	4	15	1	2	-	1	-	1	-	1
FT Lee, VA	35	119	-	-	-	1	-	-	-	-	-	-	-	-
FT Meade, MD	100	48	-	-	-	-	-	-	2	-	1	-	-	-
West Point, NY	39	33	-	-	1	1	-	-	-	-	1	-	-	-
<b>GREAT PLAINS RMC</b>														
Beaumont AMC, TX	263	195	-	-	-	5	-	-	-	-	3	4	2	-
Brooke AMC, TX	196	317	2	-	3	3	1	-	2	-	6	6	1	4
FT Carson, CO	516	501	2	2	5	-	5	4	3	8	3	5	-	1
FT Hood, TX	954	737	-	-	4	3	-	-	-	1	-	1	4	1
FT Huachuca, AZ	26	30	-	-	-	-	-	-	-	-	1	-	-	-
FT Leavenworth, KS	23	11	-	-	-	-	-	1	3	1	1	-	-	-
FT Leonard Wood, MO	150	118	1	3	3	2	-	-	1	1	1	2	-	-
FT Polk, LA	89	145	-	-	10	-	-	-	-	-	-	-	-	-
FT Riley, KS	243	220	1	1	-	11	-	-	5	-	1	-	1	-
FT Sill, OK	225	214	-	-	10	8	-	-	-	-	-	-	-	1
<b>SOUTHEAST RMC</b>														
Eisenhower AMC, GA	195	142	-	1	3	2	1	-	-	-	-	-	-	-
FT Benning, GA	186	286	2	-	13	92	3	1	-	2	2	6	3	2
FT Campbell, KY	441	411	1	2	1	9	4	16	9	4	3	15	7	77
FT Jackson, SC	168	330	1	-	3	-	-	-	-	-	1	-	1	-
FT Rucker, AL	26	37	-	-	-	1	-	-	-	-	-	-	-	-
FT Stewart, GA	331	283	1	-	24	3	-	-	-	-	-	2	1	-
<b>WESTERN RMC</b>														
Madigan AMC, WA	245	434	-	-	-	-	2	2	2	5	1	5	-	1
FT Irwin, CA	31	30	-	-	-	-	-	-	1	-	-	-	-	-
FT Wainwright, AK	39	97	9	42	-	-	1	-	-	-	-	-	-	-
<b>OTHER LOCATIONS</b>														
Tripler, HI	311	404	-	-	2	-	14	20	6	9	4	9	-	1
Europe	230	149	2	-	-	-	3	3	1	-	4	-	-	-
Korea	96	255	1	8	6	4	-	-	-	-	-	-	-	-
<b>Total</b>	<b>6065</b>	<b>7255</b>	<b>38</b>	<b>85</b>	<b>137</b>	<b>269</b>	<b>53</b>	<b>64</b>	<b>43</b>	<b>47</b>	<b>77</b>	<b>92</b>	<b>43</b>	<b>92</b>

1. Main and satellite clinics

2. Events reported by September 7, 1998 and 1999

3. Tri-Service Reportable Events, July 1998

**Table I. (Cont'd) Sentinel reportable events, US Army medical treatment facilities<sup>1</sup>**  
**Cumulative events for all beneficiaries, calendar year through August 31, 1998 and 1999<sup>2</sup>**

Arthropod-borne				Vaccine Preventable						Sexually Transmitted							
Lyme Disease		Malaria		Hepatitis A		Hepatitis B		Varicella		Chlamydia		Gonorrhea		Syphilis <sup>4</sup>		Urethritis	
Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999	Cum. 1998	Cum. 1999
3	1	-	5	2	1	-	-	4	3	42	67	20	12	-	3	8	1
-	-	-	-	-	-	1	-	-	1	23	8	2	12	-	-	2	2
1	-	-	-	-	1	-	-	1	-	110	94	33	31	4	-	-	-
1	4	1	3	-	-	-	-	-	1	-	393	-	183	-	2	-	164
-	-	1	2	-	-	2	-	6	6	76	84	31	44	1	-	4	3
-	-	-	-	-	-	-	1	8	1	82	99	31	30	-	-	-	-
1	-	1	-	-	-	-	-	18	1	127	131	46	44	-	-	-	-
-	-	-	-	-	-	1	1	-	-	19	92	15	22	-	3	-	-
2	2	-	-	-	-	-	-	4	1	45	39	6	4	3	-	34	-
9	11	-	-	1	-	1	-	1	1	16	17	6	2	-	-	-	-
-	-	1	1	-	1	-	-	8	2	185	150	55	15	1	-	-	10
-	1	1	-	4	3	2	4	2	2	123	129	36	43	1	-	-	1
-	-	-	-	-	-	-	1	3	1	331	355	66	63	1	-	95	57
-	-	-	3	-	-	8	1	3	2	537	432	259	127	2	4	130	144
-	-	-	-	-	1	-	-	-	-	18	26	5	2	-	-	-	-
-	-	1	-	-	-	-	-	-	-	17	7	1	2	-	-	-	-
-	-	-	1	-	-	-	1	20	9	70	67	28	16	-	1	22	8
-	-	1	-	-	-	-	-	-	-	62	117	14	24	1	2	-	-
-	-	2	-	-	-	-	-	3	-	173	153	55	55	1	-	-	-
-	-	1	1	-	-	8	6	-	6	109	111	69	48	-	-	27	26
-	-	1	-	-	-	1	2	-	1	168	120	19	10	-	-	-	-
-	-	-	1	-	1	1	-	2	1	114	90	43	63	-	1	3	-
1	1	-	5	-	-	-	-	5	1	287	191	117	88	1	-	-	-
-	-	1	-	3	-	-	-	7	4	108	266	40	46	1	6	-	-
-	-	-	-	-	-	-	-	-	-	22	26	4	10	-	-	-	-
-	-	1	4	-	-	-	-	3	4	95	92	82	56	-	-	122	120
-	-	-	3	-	1	-	-	3	-	151	279	20	53	-	1	63	76
-	-	-	-	-	-	2	5	-	-	25	21	3	4	-	-	-	-
-	-	-	1	-	-	-	1	-	2	26	42	2	7	-	-	-	-
-	-	1	6	1	-	1	1	-	-	196	249	53	62	-	-	-	-
4	-	-	-	-	-	3	1	5	1	167	122	25	11	2	-	-	1
-	-	12	10	2	-	8	14	1	1	43	169	15	11	-	14	-	-
22	20	26	46	13	9	39	39	107	52	3567	4238	1201	1200	19	37	510	613

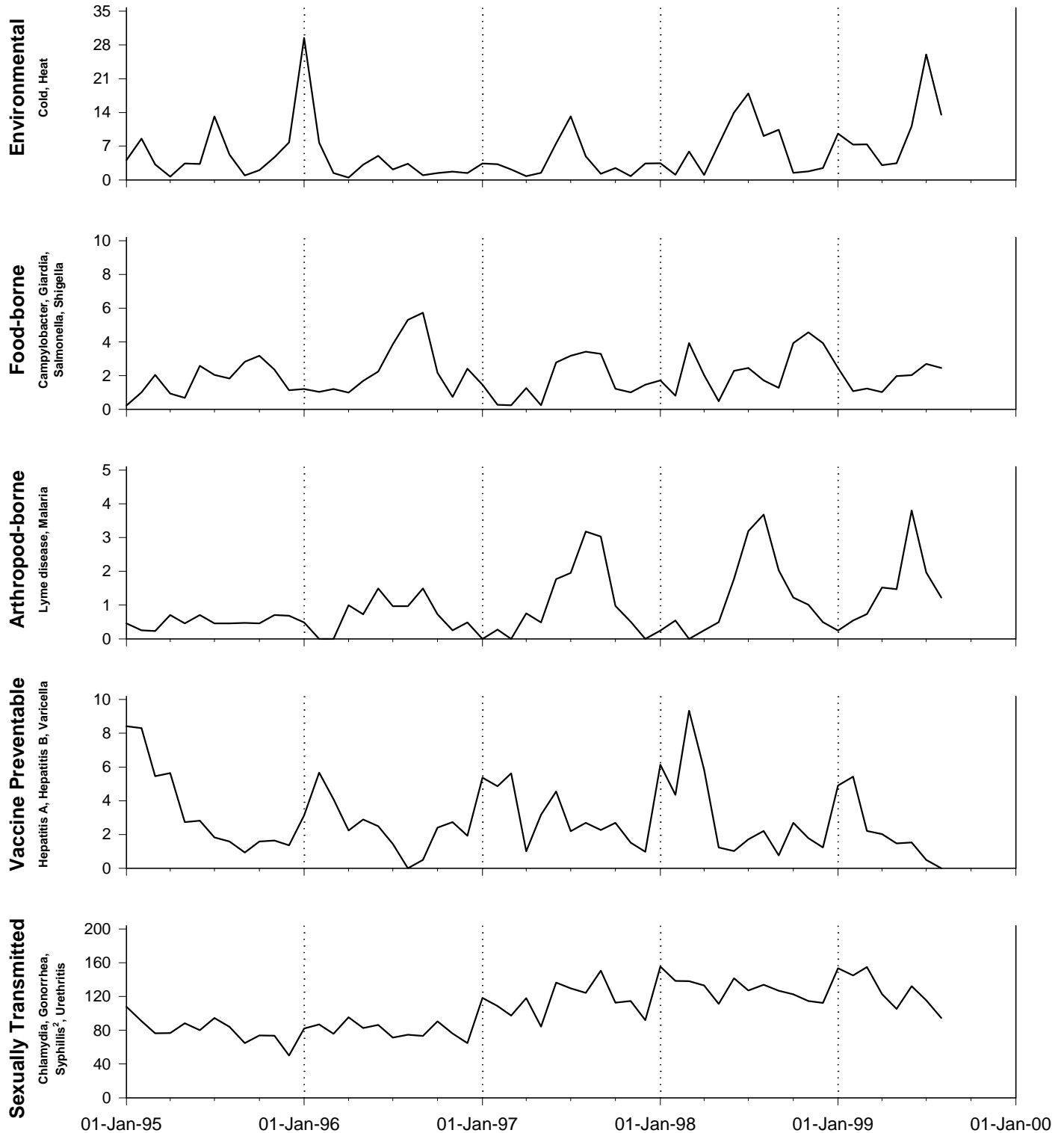
## 4. Primary and Secondary

Note: Completeness and timeliness of reporting varies by facility

Source: Army Reportable Medical Events System

**Figure I. Sentinel reportable events (grouped), active duty soldiers, January 1995 - August 1999<sup>1</sup>**

Cases / 10,000 soldier-years



1. Events reported by September 7, 1999

2. Primary and Secondary

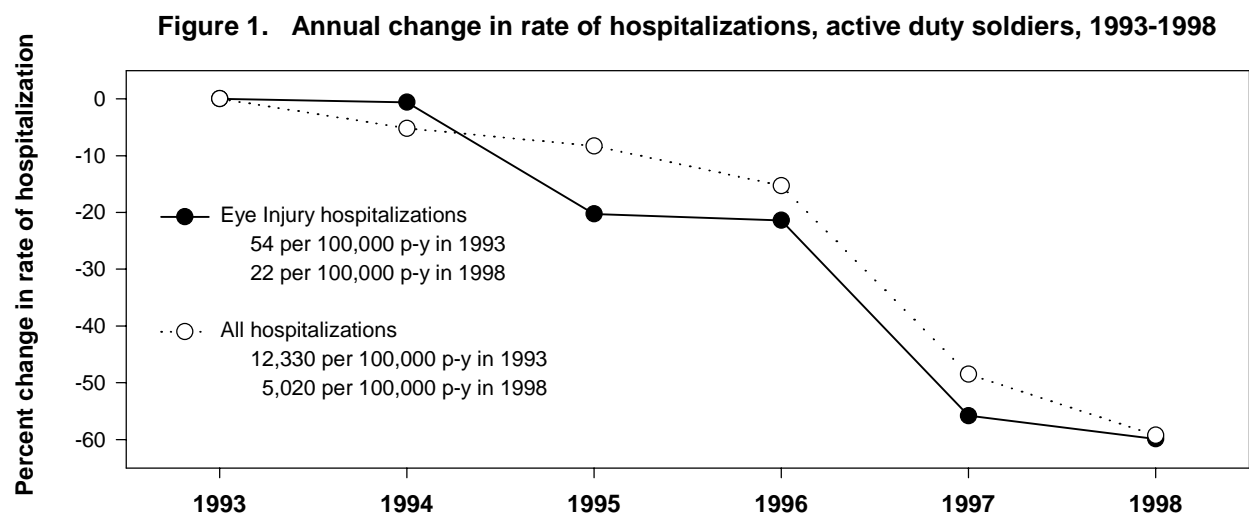
**Table 2. Incidence of eye injuries per 100,000 person-years of military service by gender and grade, active duty soldiers**

Characteristic	Hospitalizations 1993 - 1998			Ambulatory Visits 1998		
	Incident Cases	Person-years	Rate/100,000 person-years	Incident Cases	Person-years	Rate/100,000 person-years
<b>All</b>	1,265	3,108,369	40.7	5,198	479,345	1,084.4
<b>Gender</b>						
Male	1,191	2,681,091	44.4	4,406	407,903	1,080.2
Female	73	423,012	17.3	784	70,762	1,107.9
<b>Military Grade</b>						
Enlisted (E1-E2)	208	338,153	61.5	762	56,319	1,353.0
Enlisted (E3-E4)	670	1,055,045	63.5	2,040	161,245	1,265.2
Enlisted (E5-E9)	305	1,212,433	25.2	1,794	180,921	991.6
Officer (O1-O3, W1-W3)	60	323,643	18.5	406	50,529	803.5
Officer (O4-O9, W4-W5)	22	176,476	12.5	196	28,171	695.8

*Continued from page 2*

ery periods, and numbers of incident eye injury hospitalizations and ambulatory visits. Between 1993 and 1998, the number of incident eye injury hospitalizations was 1,272 (based on the short recovery period) and 1,265 (based on the long recovery period). The number of incident eye injury ambulatory visits in 1998 was 5,637 (based on the short recovery period) and 5,198 (based on the long recovery period). Since estimates of incident injuries did not vary substantially in relation to recovery period durations, the long recovery period, being the more conservative, was used for subsequent analyses.

Incidence rates of eye injury hospitalizations and ambulatory visits are shown in table 2. Among all active duty soldiers, there were 40.7 hospitalizations and 1,084.4 ambulatory visits per 100,000 soldier-years. Eye injury-related hospitalization rates were more than twice as high among males than females; however, ambulatory visit rates among males and females were remarkably similar. Both hospitalization and ambulatory visit rates were higher among enlisted soldiers than officers; among both enlisted soldiers and officers, rates were significantly higher in the junior grades. Eye injury hospitalization rates declined by more than





half between 1993 (54 per 100,000 person-years) and 1998 (22 per 100,000 person-years) (figure 1, page 7). Of note, the percent change in eye injury hospitalization rates closely reflected the percent change in all hospitalization rates during the surveillance period.

Figure 2 shows proportional distributions of eye injury hospitalizations and ambulatory visits by major diagnostic subgroups. Open wounds accounted for nearly one third (32.1%) of all eye injury hospitalizations. Superficial injuries accounted for more than half (51.6%) of all eye injury ambulatory visits.

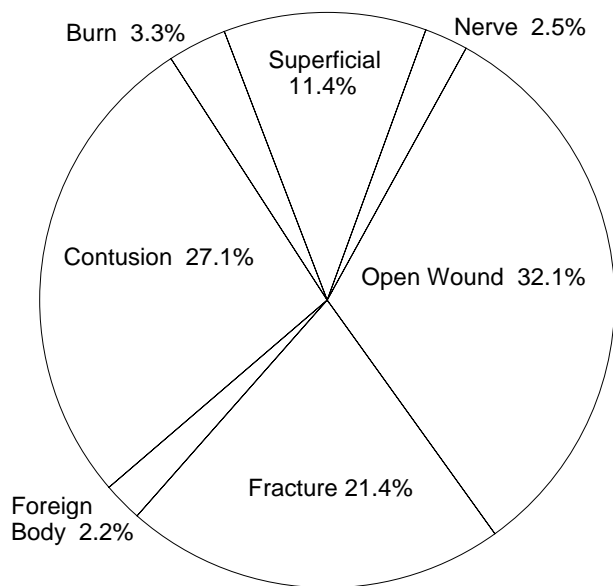
In 1998, 62.0% of the 108 enlisted occupations (based on DoD primary occupational codes) accounted for ten or more incident eye injury ambulatory visits each (table 3). The greatest number of eye injury cases occurred among infantrymen (n=604) and automotive repairers (n=326). However, the highest rates of eye injuries were among metal workers, machinists, watercraft operators, and construction equip-

ment, medical equipment, and automotive repairmen.

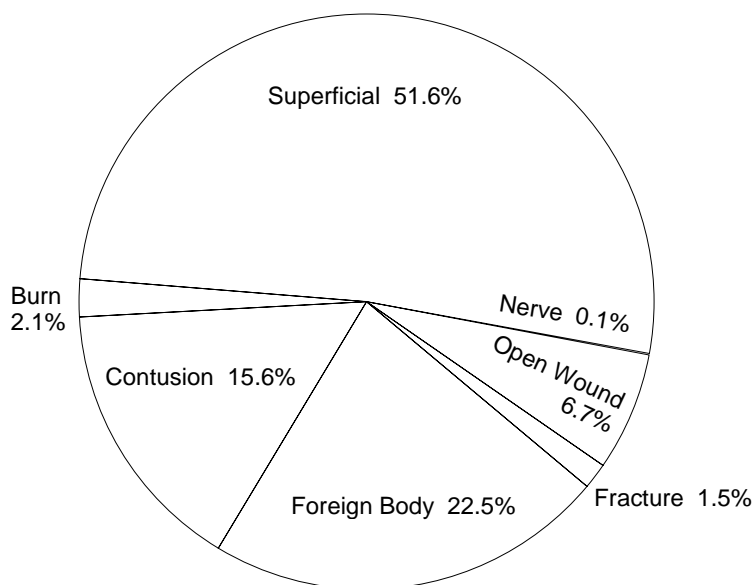
Causes of eye injury hospitalizations were examined using North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) codes, which are routinely used in US military hospitals to document external causes of injuries. From 1993 to 1998, the most frequent causes of eye injury hospitalizations were machinery, tools, and selected agents (23.7%), falls and fights (21.6%), land transport (19.0%), and athletics, sports, and physical training (14.4%) (table 4, page 10).

**Editorial comment:** Findings from these analyses document that eye injuries are a significant cause of potentially preventable morbidity among active duty soldiers. Since most eye injuries are treated in outpatient settings (in 1998, the ratio of ambulatory to hospitalized incident cases was approximately 50:1), it is important to include ambulatory cases in overall assessments of the nature, scope, and

**Figure 2. Eye injuries hospitalizations and ambulatory visits by diagnostic category, active duty soldiers**



**Hospitalizations, 1993-1998**



**Ambulatory visits, 1998**

**Table 3. Eye injury ambulatory visits per 1,000 person-years of military service by job title, active duty enlisted soldiers, 1998**

Enlisted Occupation POC <sup>1</sup> Job Title	Ambulatory visits, 1998 <sup>2</sup>	Person-years	Rate	(95%/CI) <sup>3,4</sup>
704 Metal worker	36	857	42.0	(29.4, 58.2)
702 Machinist	15	402	37.3	(20.9, 61.5)
062 Watercraft operator	16	573	27.9	(16.0, 45.3)
612 Construction equipment repairer	40	1,953	20.5	(14.6, 27.9)
326 Medical equipment repairer	13	671	19.4	(10.3, 33.1)
610 Automotive repairer	326	17,543	18.6	(16.3, 20.4)
325 Hospital food service specialist	10	540	18.5	(8.9, 34.1)
713 Construction equipment operator	58	3,221	18.0	(13.7, 23.3)
313 Radiology, nuclear medicine specialist	16	978	16.4	(9.4, 26.6)
222 Air traffic control operator	18	1,109	16.2	(9.6, 25.7)
570 Journalist, public affairs chief	11	679	16.2	(8.1, 29.0)
712 Carpentry and masonry specialist	17	1,060	16.0	(9.3, 25.7)
340 Patient administration specialist	14	901	15.5	(8.5, 26.1)
556 Aviation operations specialist	25	1,733	14.4	(9.3, 21.3)
611 Tracked vehicle repairer, field artillery mechanic	137	9,550	14.3	(11.4, 16.2)
662 Utilities equipment repairer	67	4,727	14.2	(11.0, 18.0)
042 Multiple Launch Rocket System crewmember	48	3,389	14.2	(10.4, 18.8)
822 Cargo specialist	22	1,608	13.7	(8.6, 20.7)
860 Parachute rigger	20	1,506	13.3	(8.1, 20.5)
600 Utility airplane and helicopter repairer	112	8,518	13.1	(10.6, 15.6)
011 Special forces	59	4,581	12.9	(9.8, 16.6)
020 Armor crewman, senior sergeant	165	13,005	12.7	(10.5, 14.4)
400 Multimedia illustrator, visual info.operator, chief	14	1,107	12.6	(6.9, 21.2)
301 Ear, nose, throat specialist, operating room specialist	15	1,198	12.5	(7.0, 20.7)
010 Infantryman, senior sergeant	604	48,288	12.5	(11.5, 13.5)
602 Aircraft powertrain, pneumatics, components repairer	19	1,568	12.1	(7.3, 18.9)
300 Medical, cardiovascular, respiratory specialist	234	19,338	12.1	(10.4, 13.5)
311 Medical lab, cytology, and sterile pharmacy specialist	26	2,163	12.0	(7.9, 17.6)
121 Missile guidance and control repairer	19	1,583	12.0	(7.2, 18.7)
041 Cannon crewmember, field artillery senior sergeant	141	11,753	12.0	(10.0, 14.1)
645 Ammunition specialist	30	2,508	12.0	(8.1, 17.1)
800 Food service specialist	123	10,321	11.9	(9.6, 13.9)
632 Missile system mechanic	14	1,180	11.9	(6.5, 19.9)
250 Fire specialist, cavalry scout, aeroscout observer	160	13,553	11.8	(10.0, 13.8)
330 Dental specialist	18	1,544	11.7	(6.9, 18.4)
821 Petroleum supply specialist	95	8,326	11.4	(9.2, 13.9)
643 Turret mechanic, armament repairer	24	2,106	11.4	(7.3, 17.0)
811 Motor transport operator, senior sergeant	122	10,792	11.3	(9.2, 13.3)
321 Veterinary food inspection, animal care specialist	16	1,430	11.2	(6.4, 18.2)
000 Infantry, gun crews, general	26	2,367	11.0	(7.2, 16.1)
830 Military police	152	14,142	10.7	(9.0, 12.4)
244 Counterintelligence agent, senior sergeant	12	1,122	10.7	(5.5, 18.7)
043 Rocket artillery crewmember	97	9,275	10.5	(8.5, 12.8)
500 Personnel administration specialist	120	11,527	10.4	(8.6, 12.5)
510 Administrative specialist	102	9,904	10.3	(8.2, 12.3)
101 Communications-radio operator, maintainer, chief	112	11,042	10.1	(8.2, 12.0)
494 Chemical operations specialist	62	6,156	10.1	(7.7, 12.9)
030 Combat engineer, bridge crewmember	99	9,927	10.0	(8.1, 12.1)
690 Quartermaster, chemical equipment repairer	12	1,226	9.8	(5.1, 17.1)
431 Explosive ordnance disposal specialist	10	1,022	9.8	(4.7, 18.0)
551 Automated logistical specialist	242	24,866	9.7	(8.5, 11.0)
542 Finance specialist, senior sergeant	19	1,971	9.6	(5.8, 15.1)
341 Medical supply specialist	14	1,457	9.6	(5.3, 16.1)
260 Telecommunications, network switching systems	80	8,367	9.6	(7.6, 11.9)
621 Cable systems installer, maintainer	20	2,110	9.5	(5.8, 14.6)
521 Command sergeant major	18	1,926	9.3	(5.5, 14.8)
950 Not occupationally qualified	27	2,899	9.3	(6.1, 13.6)
012 Instructor	20	2,246	8.9	(5.4, 13.8)
102 Satellite, avionic communications repairer	101	11,736	8.6	(6.9, 10.4)
232 Signals intelligence analyst	16	2,124	7.5	(4.3, 12.2)
450 Musician	15	2,020	7.4	(4.2, 12.2)
201 Radio operator, maintainer	10	1,413	7.1	(3.4, 13.0)
531 Information systems operator, analyst, chief	18	2,797	6.4	(3.8, 10.2)
512 Legal specialist	10	1,554	6.4	(3.1, 11.8)
243 Psychological op., intelligence analyst, ground surveillance	27	4,399	6.1	(4.0, 8.9)
501 Recruiter, career counselor	19	3,905	4.9	(2.9, 7.6)
231 Voice, (non)morse interceptor operator, analyst	17	4,231	4.0	(2.3, 6.4)

1 Department of Defense Primary Occupation Code.

2 Only job titles with 10 or more ambulatory visits are listed (67 out of 108 job titles).

3 95% confidence interval based on Poisson distribution.

4 Rate calculated per 1,000 person-years.

**Table 4. Cause of eye injury hospitalizations, active duty soldiers, 1993-1998**

STANAG Code <sup>1</sup>	Cause of Injury	Incident Hospitalizations 1993-1998	Percentage
000-059	Accident in air transport, spacecraft, and escape system	16	1.3
100-149	Accident in land transport	238	19.0
159-199	Accident in water transport	0	0.0
200-249	Athletics, sport, physical training	180	14.4
300-479	Injury due to war, instrumentalities employed by enemy	3	0.2
480-499	Injury due to war, instrumentalities employed by allies	0	0.0
500-599	Injury due to guns, explosives, and related agents	95	7.6
600-699	Injury due to machinery, tools, and selected agents	297	23.7
700-799	Injury due to poison, fire, hot or corrosive substances	38	3.0
800-899	Injury due to specified environmental factors	10	0.8
900-979	Injury due to falls and fights	270	21.6
980-999	Injury due to misc., other, and unspecified agents	104	8.3
<b>Total</b>		<b>1,265</b>	<b>100.0</b>

<sup>1</sup> North Atlantic Treaty Organization STANdardization AGreement codes characterize external causes of injuries for all Department of Defense hospitalizations.

impacts of the problem. The Defense Medical Surveillance System (DMSS) provides a unique capability to conduct such a comprehensive population-based assessment.

In 1998, there were 11.1 eye injuries (hospitalized and ambulatory cases) per 1,000 active duty soldiers. The rate slightly exceeds those estimated from population-based surveys of US nonmilitary populations. For example, National Health Interview Surveys (NHIS) in the 1970s found that eye injury rates were 9.48 (in 1972) and 10.98 (in 1977) per 1,000 annually. In 1985, a population-based survey of New England adults estimated that eye injury incidence was 9.75 per 1,000 per year.<sup>7</sup>

The slightly higher eye injury rate among soldiers compared to general civilian populations should be interpreted cautiously. For example, compared to general populations of US adults, active duty soldiers overrepresent physically active young males with inherently hazardous occupations that are often performed under stressful conditions (e.g., at night in the field during combat operations). On the other hand, the conservative methods used for these analyses may significantly underesti-

mate the true magnitude and extent of eye injuries among soldiers. For example, conditions that may represent acute or late effects of injuries but are coded with other than injury-related diagnoses (e.g., hyphema, iritis, photokeratitis, retinal detachment, corneal edema) were not included as eye injury cases.

Among soldiers, eye injury hospitalization rates were more than twice as high among males than females, while ambulatory visit rates were comparable between the gender subgroups. Approximately one third of eye injury hospitalizations were for open wounds while over one half of ambulatory visits were for superficial injuries. While this summary could not distinguish between on and off duty injuries, the higher rates of more severe injuries among males may reflect their exposures to inherently greater duty-related hazards (e.g., infantry) and/or their participation in more risky off duty behaviors (e.g., automotive repair, fighting, contact sports).

In the Army, work-related injuries accounted for more eye injury hospitalizations than any other category of causes. While infantrymen incurred the

greatest number of eye injuries, tradesmen (e.g., welders, metal workers, repairmen) had the highest eye injury rates. It is not known whether the eye injuries of soldiers occurred on or off duty. It is also not known whether eye protection was indicated or worn at the time of the injuries. It seems likely, however, that many eye injuries of active duty soldiers could have been prevented by the use of safe and effective eyewear.<sup>8-10</sup>

*Analysis and report provided by Gabriella Andreotti, MPH, and Jeff L. Lange, PhD, Analysis Group, Army Medical Surveillance Activity (AMSA).*

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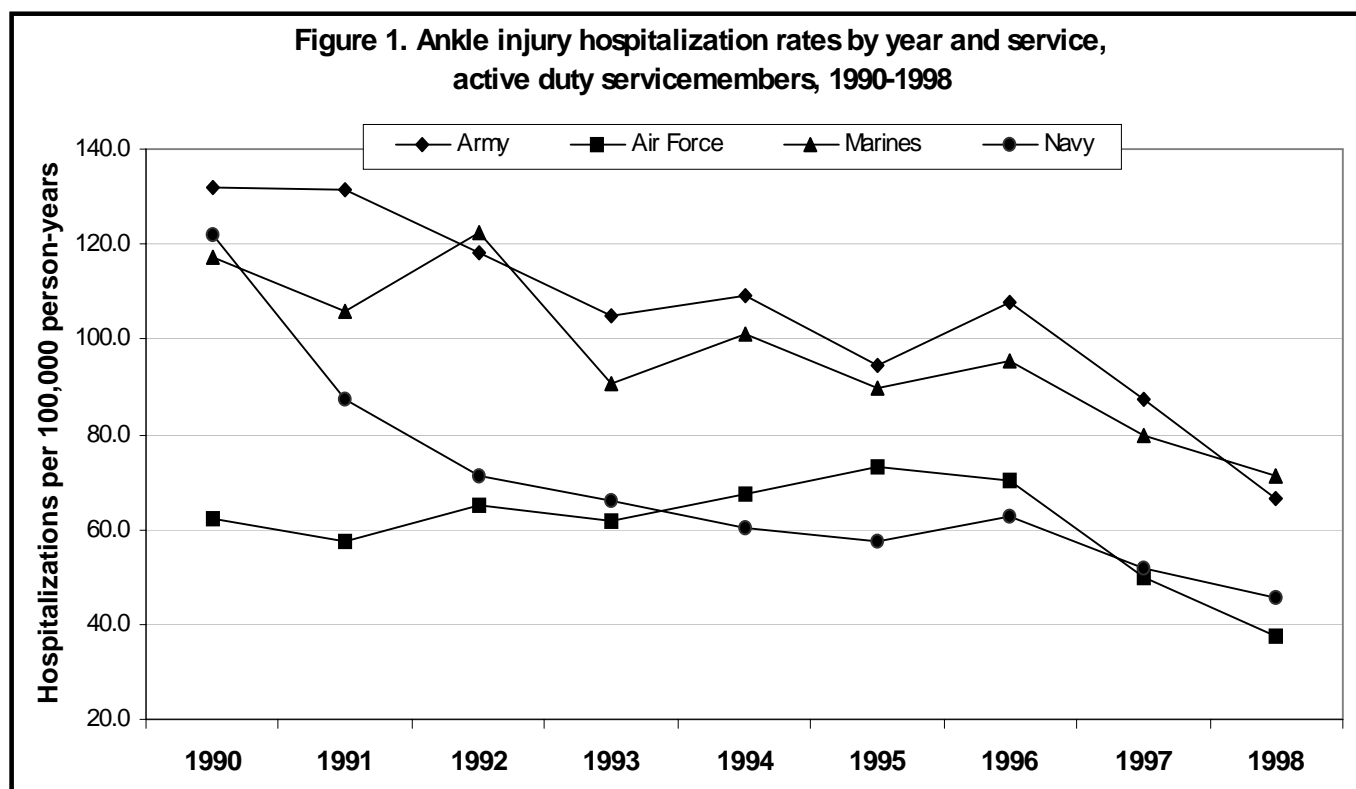
## Surveillance Trends

### **Ankle Injuries among Active Duty Servicemembers, US Armed Forces, 1990-1998**

Military servicemembers are exposed to many activities that increase their risks of lower limb injuries, especially ankle injuries. These activities include athletics participation, physical training, parachuting, rappelling, climbing, jumping, and marching<sup>3/4</sup> often with heavy loads.<sup>1</sup> Among members of the US Armed Forces, injuries and poisonings (codes 800-999, International Classification of Diseases, 9<sup>th</sup> revision, Clinical Modifications [ICD-9-CM]) have been the second leading cause of ambulatory visits (1997-1998) and the fourth leading cause of hospitalizations (1990-1998). In recent years, within the injury and poisoning category, ankle sprains have been the leading cause of ambulatory visits (1997-1998) while ankle fractures have been the second leading cause of hospitalizations (1990-1998).<sup>2</sup> This re-

port summarizes frequencies, rates, and trends of ankle injury-related hospitalizations and ambulatory visits among active duty servicemembers and identifies correlates of ankle injury risk.

**Methods:** Standard inpatient (SIDR) and ambulatory (SADR) data records maintained in the Defense Medical Surveillance System (DMSS) were searched to identify all hospitalizations between 1990 and 1998 and all ambulatory visits between 1997 and 1998 with primary or secondary diagnoses of ankle fracture (ICD-9-CM code 824), ankle sprain (ICD-9-CM code 845.0), or ankle dislocation (ICD-9-CM code 837). When an individual had an ankle injury as both a primary and secondary diagnosis, the primary diagnosis was considered the reason for the hospitalization or ambulatory visit.



Cases were categorized as incident or follow-up. An incident case was defined as an individual's first ankle injury visit during the study period or a visit at least 6 months after a prior initial visit. Visits that occurred within 6 months of an initial visit were considered follow-ups.

*Hospitalizations, overall:* From 1990 to 1998, there were 13,356 hospitalizations for ankle-related injuries among active duty servicemembers. Of these, 12,777 (96%) hospitalizations of 12,696 individuals were considered incident cases. Only incident cases were considered for subsequent analysis.

Between 1990 and 1998, ankle injury hospitalization rates were higher in the Army and Marines than in the other Services (figure 1). Among all servicemembers, hospitalization rates for ankle injuries declined by 51% between 1990 and 1998. Hospitalization rates for all causes declined by 64% during the same period.

Of all ankle-related hospitalizations, approximately two-thirds (66%) were due to fractures,

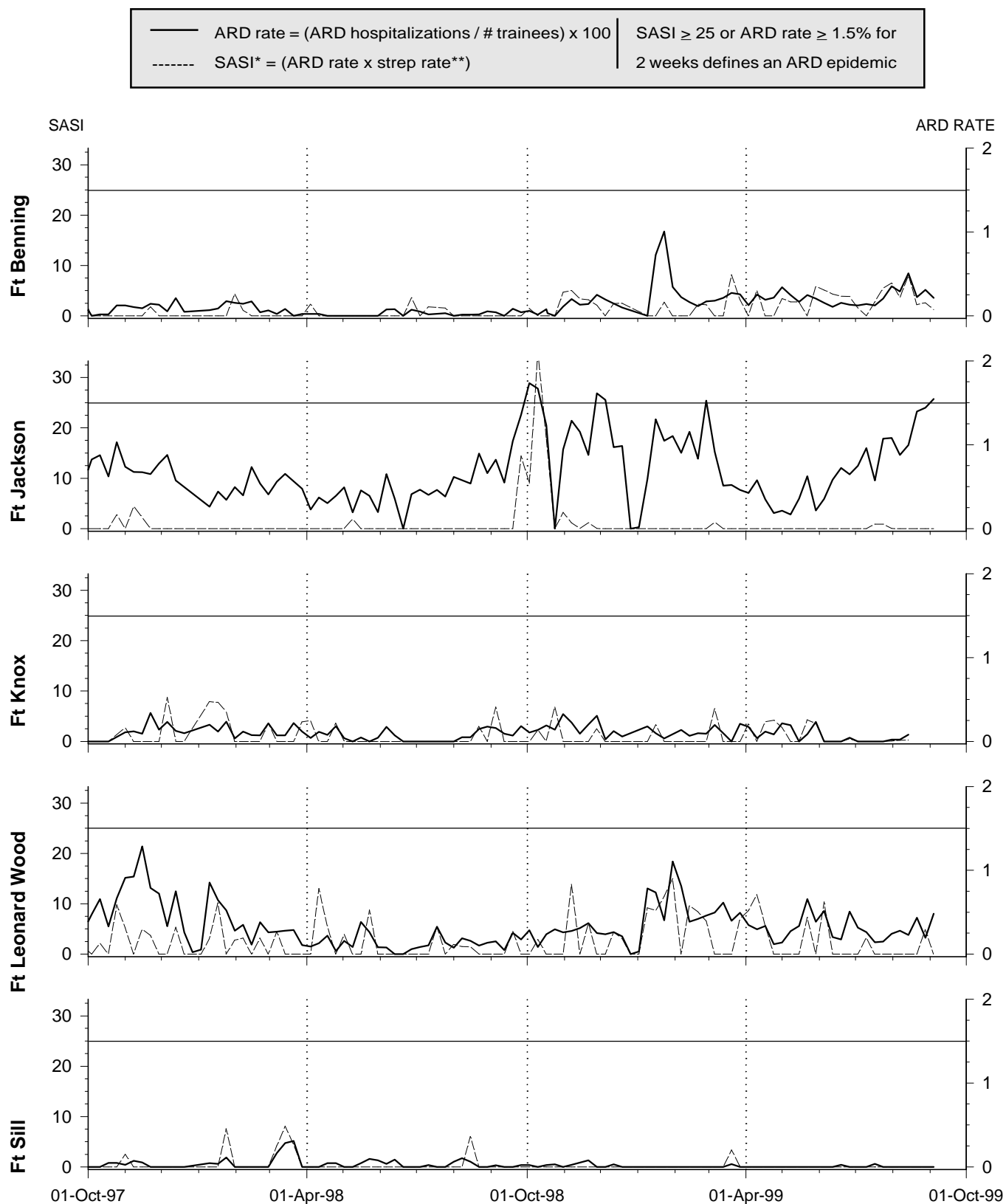
nearly one-third (31%) were due to sprains, and the remainder (3%) were due to dislocations. Compared to the overall distribution, Marines had a relatively higher proportion of fracture-related hospitalizations (77%) while the Air Force had relatively more sprains (41%). Table 1 (page 14) shows hospitalization rates for specific types of ankle injuries by Service.

*Hospitalizations, demographic (table 1, page 14):* Among all servicemembers, ankle injury hospitalization rates were nearly twice as high among males as females. Compared to females, males were 2.7 and 1.6 times as likely to be hospitalized for ankle sprains and ankle fractures, respectively.

Ankle injury hospitalization rates were higher among black servicemembers than others. The higher overall ankle injury rate among black servicemembers was almost entirely attributable to a higher incidence of ankle sprains. The hospitalization rate for ankle sprains among black servicemembers was more than twice as high as the rates in other racial/ethnic subgroups. There

*Continued on page 14*

**Figure II. Acute respiratory disease (ARD) surveillance update  
US Army initial entry training centers**



\* SASI (Strep ARD Surveillance Index) is a reliable predictor of serious strep-related morbidity

\*\* Strep rate = (Group A beta-hemolytic strep(+) / # cultures) x 100

*Continued from page 12*

were not significant race/ethnicity-related differences in ankle fracture or dislocation hospitalizations.

Ankle injury rates generally declined with increasing age, rank, and length of service. Ankle sprains were a notable exception, however, as hospitalization rates, particularly among black males, increased with age.

Among enlisted servicemembers, the highest ankle injury rates were among "infantry, gun crews, and seamanship specialists" (120 per 100,000 person-years). Among officers, the highest rates were among those in intelligence (71 per 100,000 person-years) and tactical operations (69 per 100,000 person years) occupational categories.

*Hospitalizations, external causes of injury:* External cause of injury codes (STANAG) were available for 11,771 (92%) of the incident cases.

Approximately equal proportions of ankle injury hospitalizations were related to sports/athletic events (43%) and falls, jumps, and miscellaneous other or unspecified agents (37%). Most sprains (69%) and dislocations (57%) were sports-related, while fractures were more often associated with falls, jumps, and miscellaneous other or unspecified agents (41%).

The activity most frequently associated with ankle sprain hospitalizations was basketball (41.4%, n=1,418). Two-thirds of hospitalizations for basketball-related ankle sprains were among black servicemembers. The rate of hospitalizations for basketball-related ankle sprains was 7.9 times higher among black servicemembers than others.

The activity most frequently associated with ankle fracture hospitalizations was military para-

**Table 1. Ankle injury hospitalizations and rates (per 100,000 person-years), by service, 1990-1998**

Characteristics		Army		Air Force		Marine		Navy		All Servicemembers	
		Incident cases	Rate	Incident cases	Rate	Incident cases	Rate	Incident cases	Rate	Incident cases	Rate
<b>Total</b>		<b>5,668</b>	<b>108.6</b>	<b>2,389</b>	<b>60.8</b>	<b>1,592</b>	<b>97.7</b>	<b>3,128</b>	<b>71.7</b>	<b>12,777</b>	<b>84.4</b>
<b>Injury type</b>	Fractures	3,939	75.5	1,350	34.4	1,231	75.5	1,949	44.7	8,469	55.9
	Dislocations	1,596	30.6	986	25.1	316	19.4	1,085	24.9	3,983	26.3
	Sprains	133	2.5	53	1.3	45	2.8	94	2.2	325	2.1
<b>Gender</b>	Male	5,232	115.1	2,193	66.0	1,538	99.1	2,921	75.3	11,884	89.4
	Female	436	65.5	196	32.3	54	69.2	207	42.8	893	48.7
<b>Race or ethnicity</b>	White, nonhispanic	3,515	109.4	1,614	52.8	1,096	95.2	2,106	68.9	8,588	79.5
	Black, nonhispanic	1,587	110.0	591	100.6	307	111.1	725	102.5	3,532	106.5
	Hispanic	268	104.2	98	68.4	131	92.0	208	75.5	969	86.1
	Asian/Pacific Islander	104	96.4	34	46.6	22	81.3	61	29.5	445	53.3
	Native American	38	113.2	20	82.4	16	110.4	18	68.3	398	93.3
	Other/unknown	156	94.8	32	70.4	20	104.3	10	43.1	492	86.4
<b>Age group</b>	< 20	539	139.7	98	52.8	201	90.1	230	67.2	1,351	94.0
	20-24	2,031	120.3	581	60.9	779	104.4	1,213	85.0	4,890	95.6
	25-29	1,336	112.5	537	58.5	282	100.6	686	72.2	3,113	85.2
	30-34	867	99.9	541	67.3	171	95.3	521	71.3	2,363	81.4
	35-39	595	92.5	409	63.3	110	86.5	324	58.6	1,680	73.0
	>=40	300	68.0	223	53.3	49	66.1	154	42.5	913	56.0

**Table 2. Top 15 causes of ankle injury hospitalizations by diagnosis, active duty servicemembers, 1990-1998**

Cause of injury	Fractures	Dislocations	Sprains	Total
Basketball	316	83	1,418	1,817
Other fall or jump from one level to another	934	19	150	1,103
Twisting, turning, slipping, running, etc. (without fall)	709	20	316	1,045
Parachuting, initial impact with ground	936	10	14	960
Falls or jumps on same level	734	9	105	848
Other athletics and sports	482	11	316	809
Football (American)	489	13	179	681
Softball and rounders	438	34	104	576
Fall on or jump from stairs or ladder	431	10	96	537
Other specified agents not classifiable	295	14	164	473
Motorcyclist (driver or other rider)	323	5	26	354
Soccer and football	226	1	69	296
Baseball	202	11	50	263
Driver of motor vehicle (not motorcycle or semi-tracked vehicle)	166	6	13	185
Parachuting, other/unspecified	164	2	4	170
<b>Total</b>	<b>8,061</b>	<b>283</b>	<b>3,427</b>	<b>11,771</b>

chuting (13.8%, n=1,109). Sports such as football (n=489), softball (n=438), basketball (n=316), soccer (n=226), and baseball (n=202) were also frequently associated with ankle fracture hospitalizations.

*Ambulatory visits, overall:* During 1997 and 1998, there were 292,193 ambulatory visits due to ankle injuries among active duty servicemembers. Of these, 93,844 (32%) visits among 88,845 servicemembers were considered incident cases. Only incident cases were considered for subsequent analysis.

Approximately 90% of all ankle-related ambulatory visits were due to sprains. The Army had the highest ankle injury ambulatory visit rate (47.2 per 1,000 person-years), followed by the Marines (38.7 per 1,000 person-years), Air Force (23.7 per 1,000 person-years), and Navy (20.9 per 1,000 person-years).

*Ambulatory visits, demographic:* In each Service except the Air Force, females had higher rates of ankle injury visits than males. Rates did

not significantly vary in relation to race/ethnicity. (See table 3, page 16.)

Rates of ankle injuries declined with increasing age. However, while rates of ankle sprains declined with age, rates of ankle fractures increased from the <20 to the 20-24 and 25-29 year age groups before declining.

Finally, the ankle injury rate among enlisted servicemembers (65.4 per 1,000 persons per year) was nearly twice as high as that among officers (36.3 per 1,000 persons per year). In relation to DoD primary occupational categories, among enlisted members the highest rate by far (123.5 per 1,000 person-years) was in the "non-occupational" category (which includes initial entry trainees); the highest rate among officers (42.8 per 1,000 person-years) was among "administrators."

**Editorial comment:** Ankle injuries cause significant morbidity among active duty servicemembers, particularly in the Army and



Marine Corps. Parachuting accounts for more ankle fracture-related hospitalizations than any other military activity. In general, however, sports participation accounts for more ankle injury hospitalizations than any other category of activities. Ankle sprains, particularly among black men in their late twenties and early thirties, are very strongly associated with basketball participation. Ankle fractures are associated with a wider spectrum of sports activities including football, soccer, basketball, softball, and baseball. Prevention efforts should focus on the development, testing, and broad implementation of devices (e.g., braces for use during parachuting<sup>1</sup> and basketball<sup>3</sup>) and procedures (e.g., mandatory use of "break-away" bases for baseball and softball<sup>4,5</sup>)

that protect ankles during high-risk military and recreational activities.

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**Table 3. Ankle injury ambulatory visits and rates (per 1,000 person-years), by service, 1997-1998**

Characteristics		Army		Air Force		Marine		Navy		All Servicemembers	
		Incident cases	Rate	Incident cases	Rate	Incident cases	Rate	Incident cases	Rate	Incident cases	Rate
<b>Total</b>		<b>45,401</b>	<b>47.3</b>	<b>17,569</b>	<b>23.7</b>	<b>13,343</b>	<b>38.7</b>	<b>17,531</b>	<b>20.9</b>	<b>93,844</b>	<b>20.9</b>
<b>Injury type</b>	Fractures	4,380	4.6	1,351	1.8	1,374	4.0	1,694	2.0	8,799	3.0
	Dislocations	356	0.4	26	0.0	38	0.1	100	0.1	520	0.2
	Sprains	40,665	42.3	16,192	21.9	11,931	34.6	15,737	18.8	84,525	29.3
<b>Gender</b>	Male	36,869	45.0	14,631	24.0	12,060	37.0	14,419	19.6	77,979	31.3
	Female	8,532	60.4	2,938	22.6	1,283	68.7	3,112	29.8	15,865	40.2
<b>Race or ethnicity</b>	White, nonhispanic	27,636	47.6	12,698	22.5	8,866	37.2	11,235	21.6	60,435	31.7
	Black, nonhispanic	11,920	46.3	3,140	27.8	2,329	42.8	3,530	25.9	20,919	37.3
	Hispanic	3,089	49.0	891	27.8	1,519	39.5	1,541	25.3	7,040	36.2
	Asian/Pacific Islander	1,142	47.1	430	26.1	305	43.8	880	20.2	2,757	30.2
	Native American	357	53.6	94	25.5	136	42.9	260	39.0	847	42.0
	Other/unknown	1,257	40.9	316	30.2	188	43.1	85	18.8	1,846	36.8
<b>Age group</b>	< 20	6,969	89.2	1,632	42.0	2,973	58.9	2,533	42.7	14,107	62.2
	20-24	16,181	56.2	5,818	32.6	6,444	40.5	5,750	23.9	34,193	39.5
	25-29	10,632	47.4	3,777	24.6	1,981	34.9	3,820	21.3	20,210	32.9
	30-34	5,934	36.3	2,654	18.2	892	26.2	2,372	16.4	11,852	24.3
	35-39	3,579	29.3	2,386	17.0	710	25.2	1,963	14.9	8,638	20.4
	>=40	2,106	24.9	1,302	15.4	343	20.6	1,093	13.2	4,844	18.0

*Surveillance Trends***Causes of Injury and Poisoning-Related Hospitalizations, US Army, 1998**

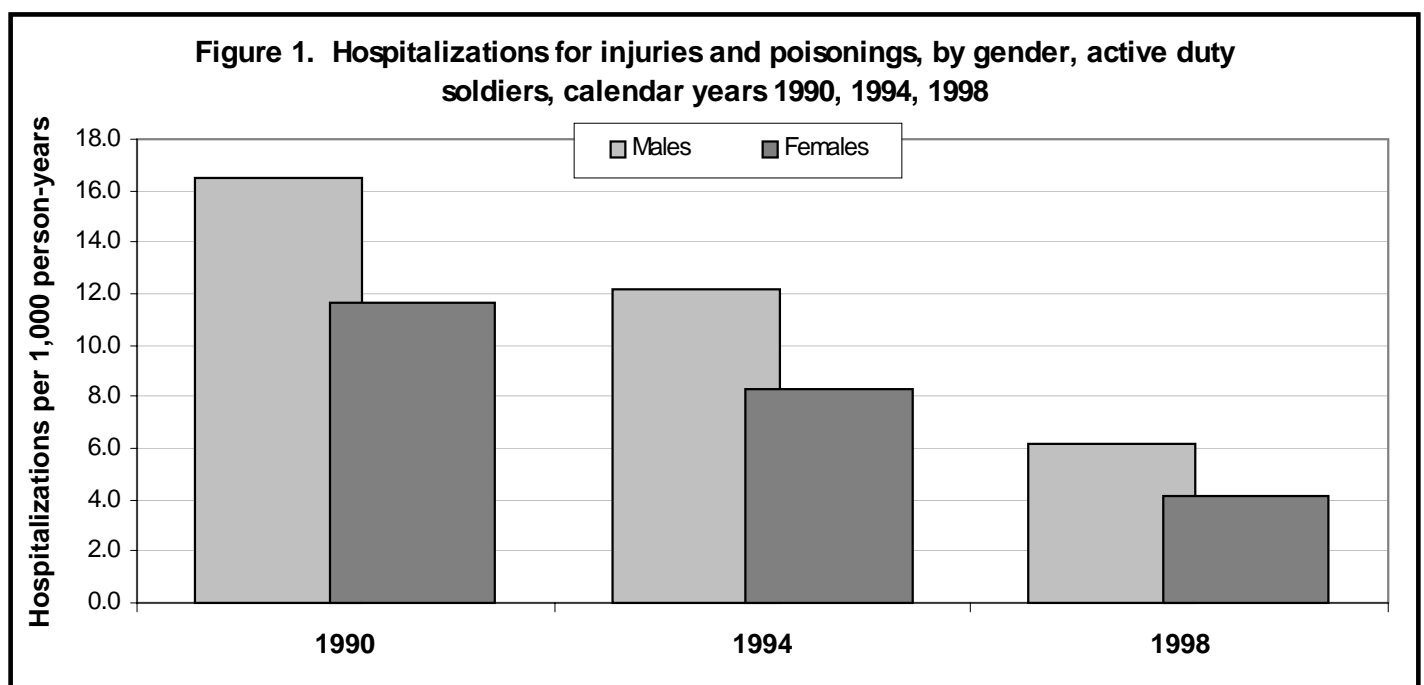
Since the early 1960s, there has been standardized reporting of causes of all injuries and poisonings that resulted in hospitalizations in US military hospitals. To this end, "external causes of injuries" have been characterized using a classification system defined in a North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG).<sup>1</sup> In US military hospitals, the STANAG system is used instead of the Classification of External Causes of Injury and Poisoning ("E-Codes") of the International Classification of Diseases since it is more complete regarding military-specific injuries.

*STANAG classification of external causes:* STANAG cause of injury codes have two parts. The first part, the general trauma code, distinguishes between battle injuries, intentionally inflicted nonbattle injuries, and accidental injuries. The second part, the causative agent code, characterizes injury and poisoning-related hospitalizations in terms of 276 possible mechanisms.<sup>2</sup> The strengths of the STANAG classification system

include its simplicity, its long and consistent use, and its focus on militarily relevant causes.

For this summary, all hospitalizations of US soldiers for injuries and poisonings (i.e., primary discharge diagnoses between 800 and 999, International Classification of Diseases, 9th revision, clinical modification) were identified for calendar years 1990, 1994, and 1998. For each injury and poisoning-related hospitalization, the "external cause of injury" was ascertained from the standard inpatient data record. Results were summarized among all soldiers and in gender-defined subgroups.

*Results, general:* Among soldiers overall, hospitalization rates for injuries and poisonings declined by more than 60% between 1990 (rate: 16.0 per 1,000 per year) and 1998 (rate: 5.9 per 1,000 per year). In 1998, injury and poisoning-related hospitalization rates were approximately 50% higher among males (6.2 per 1,000 per year) than females (4.2 per 1,000 per year); however, during the 1990s, injury and poisoning hospitalization



rates declined comparably in both genders (figure 1).

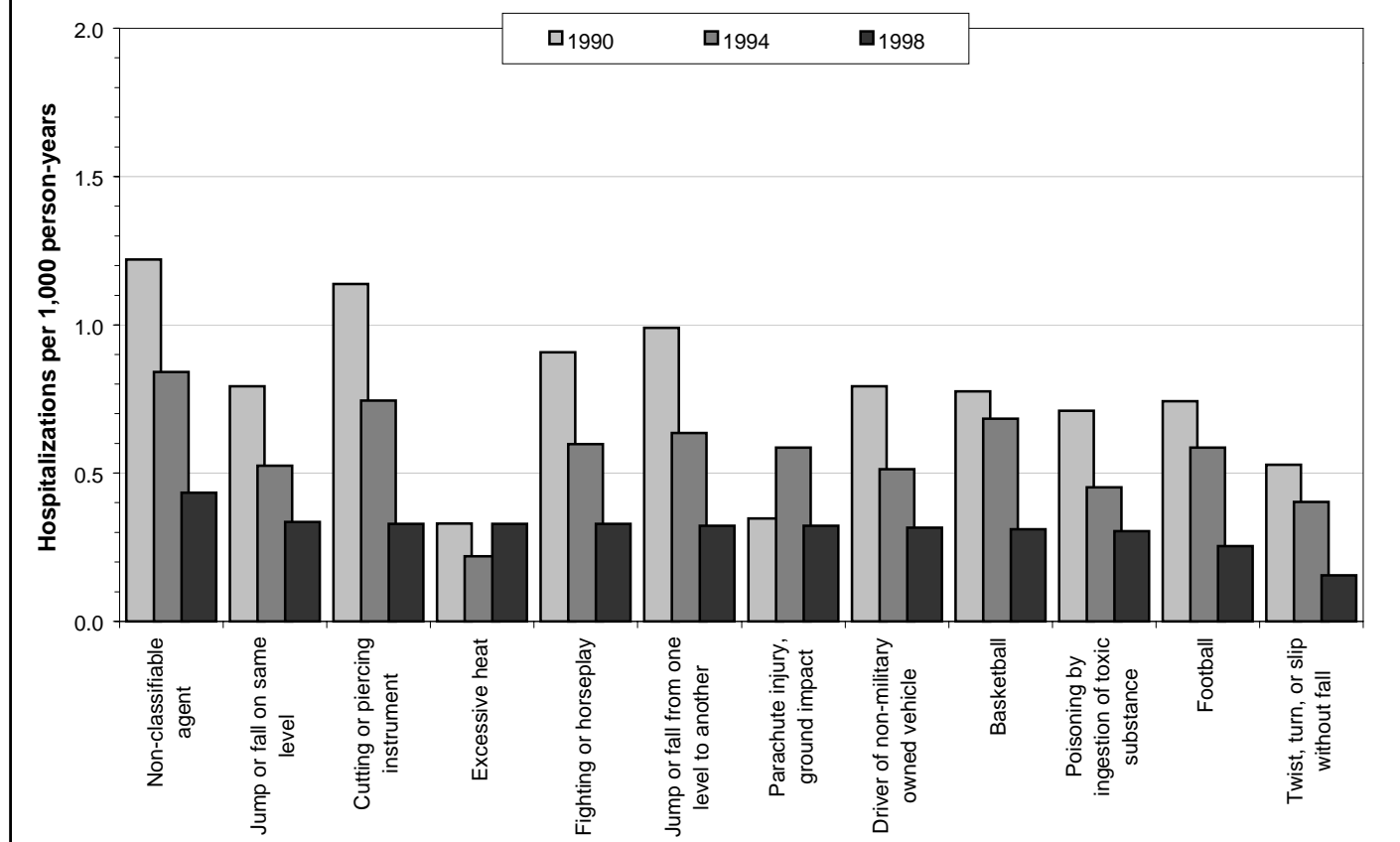
In 1998, among males, more than 93% of hospitalized injury and poisoning cases were accident-related. The most common causes of injury and poisoning hospitalizations were “non-classifiable agents,” jumps and falls, cutting and piercing instruments, excessive heat, fighting, parachuting, and sports participation (particularly basketball and football). Between 1990 and 1998, hospitalizations rates declined significantly in relation to all leading causes except excessive heat and parachuting (figure 2).

In 1998, among females, more than 85% of hospitalized injury and poisoning cases were accident-related—still, 14.2% resulted from intentional acts. Poisonings by ingestion of toxic substances (which include accidental and inten-

tional overdoses and improper uses of drugs while not under medical supervision) accounted for 22.0% of all injury and poisoning hospitalizations. During the 1990s, hospitalization rates declined for all leading causes of injury and poisoning hospitalizations among females. However, the *proportion* of injury and poisoning hospitalizations related to poisonings by ingestion increased during the decade. Other relatively frequent causes of injury and poisoning hospitalizations of females were jumps and falls, nonmilitary motor vehicle accidents, and excessive heat (figure 3).

**Editorial comment:** Among active duty soldiers, injuries and poisonings are a significant source of morbidity and disability and an important obstacle to military operational effectiveness. In 1998, for example, injuries and poisonings were the third

**Figure 2. Hospitalizations for injuries and poisonings, by external causes, male active duty soldiers, calendar years 1990, 1994, 1998**



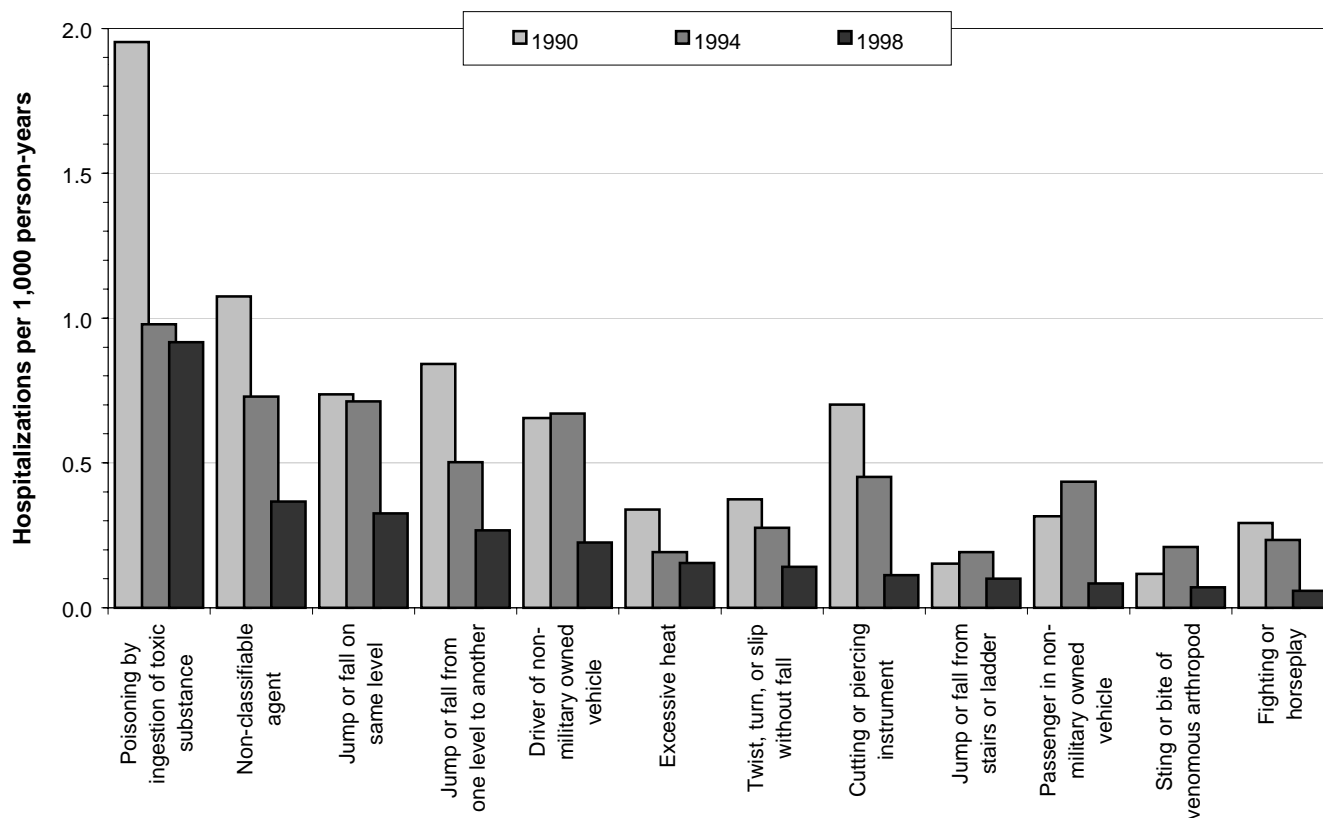
leading category of hospitalizations and lost-duty days among soldiers (behind only mental and pregnancy-related hospitalizations).<sup>3</sup> For decades, patient administration staffs at US military hospitals have ascertained and reported “external causes” of injuries and poisonings that resulted in hospitalizations. Summaries of these data suggest that jumps and falls, motor vehicle accidents, and excessive heat are major causes of injuries among both male and female soldiers. In turn, personal and motor vehicle safety programs and heat casualty prevention programs should continue to be developed for and delivered to all soldiers. Among males, in particular, there was significant morbidity related to fighting, parachuting, and sports participation (particularly basketball and football), while among females, ingestion of toxic substances was the leading cause of injury and poisoning

hospitalizations. Injury prevention programs should be emphasized among specific subgroups of soldiers (e.g., football and basketball players, parachutists) at specific locations (e.g., locker rooms, gymnasiums, airborne troop barracks, bars and clubs that serve alcohol). Poisoning prevention efforts should be integrated with suicide prevention, stress management, and unit and community mental health programs.

#### References

1. Military Agency for Standardization. North Atlantic Treaty Organization (NATO). Standardization Agreement (STANAG) No. 2050, Subject: Statistical classification of diseases, injuries, and causes of death.
2. Appendix B: External causes of injury — detailed code list, *in* Tri-service disease and procedure coding guidelines. <http://pasba.tricare.osd.mil/dodguide.html>.
3. USACHPPM. Hospitalization summary, 1998. Medical Surveillance Monthly Report (MSMR), supplement 1, 1999, 5:3(April), 14-7.

**Figure 3. Hospitalizations for injuries and poisonings, by external causes, female active duty soldiers, calendar years 1990, 1994, 1998**



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